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Interactive comment on "Development and testing of scenarios for implementing Holocene LULC in Earth System Model Experiments" *by* Sandy P. Harrison et al.

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Response to reviewer RC2 Comments in italics, response in normal script, suggested changes to text in bold. We note that several of these comments are similar to those posted by Erik KjellstroÌĹm, and in these cases we have already responded and note this here.

How are these LULC reconstructions better/different than HYDE and KK10? Are the methods different? Do we know that it is better? This may be obvious for everyone in the LULC business, but it is not explicitly explained in the text, at least not as far as I can see. The LULC reconstructions we are proposing will be refinements of HYDE and

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Discussion paper

KK10 that take account of a wider range of archaeological data. We describe these data in Section 3 and how they will improve the current HYDE and KK10 scenarios in section 4. In response to comments by the other reviewers, we have expanded the text in both of these sections to be more explicit about the data and how these data will be incorporated into the existing scenarios. The main improvements hinge on having better estimates of population changes based on the density of archaeological settlement evidence, better information for the initiation of agriculture in a region, more regionally specific information about land use, and more nuanced information about land-use per capita than the somewhat generic estimates used in KK10 or the single global assumption about land-use per capita that underpins HYDE. Until these data are used to revise the scenarios, and tested against independent data (as described in Sections 5, 6 and 7), we cannot be sure what impact they will have. Our contention is that it is surely better to incorporate information about human exploitation of the landscape than to rely on estimates that we know are based on relatively simple assumptions and which, in any case, differ markedly from one another as a consequence of these assumptions. We will take the opportunity to make a clearer statement about this in our final outcomes and perspective section, as follows: LandCover6k has developed a protocol for using archaeological information to improve existing scenarios of LULC changes during the Holocene, specifically by using archaeological data to provide better estimates of regional population changes through time, better information on the date of initiation of agriculture in a region, more regionally specific information about the type of land use, and more nuanced information about land-use per capita than currently implemented in the LULC scenarios generated by HYDE and KK10. While the final global archaeological data sets are still in production, fast-track priority products have been created and their impact on current LULC scenarios is being tested.

Is it possible to do uncertainty ranges? Some regions will inevitably be more uncertain than others. When you do a global map you tend to think that the uncertainties are the same everywhere. How do you deal with that? Also, the paper kind of assumes that data availability is as good as for the northern hemisphere in all of the world. I guess

a lot of your methods won't work that well in parts of the world. How do you deal with that? We are fully aware that the amount and quality of the archaeological data inputs is not the same everywhere, and indeed we state this in our outcomes and perspective section (line 512 et seq.). Nevertheless, incorporating information from regions where the data is good and identifying regiona where there is less certainty will certainly go some way to improving the scenarios. It should be remembered that the archaeological itself is only input to the scenarios and that both HYDE and KK10 interpolate these data to generate global scenarios of land use. It is certainly possible an our intention to provide uncertainty ranges on the estimates (see for e.g. the caption to Figure 5). These can be used to generate for example high-end and low-end scenarios of LULC change, a practice that parallels the implementation of LULC changes in future simulations. We did not spell this out clearly in the paper, and so we will take the opportunity to do so, as follows: Although the work of LandCover6k will provide more solid knowledge about anthropogenic modification of the landscape, some information will inevitably be missing and some key regions will be poorly covered. There will still be large uncertainties associated with LULC scenarios. Documenting these uncertainties is an important goal of the LandCover6k project, and will allow the generation of multiple scenarios comparable to the "low-end", "high-end" scenarios used for e.g. in future projections. Furthermore, we have proposed a series of tests that will help to evaluate the realism of the final scenarios, based on independent evidence from pollen-based reconstructions of land cover, reconstructions of climate, and carbon-cycle constraints. These tests should help in identifying which of the potential LULC reconstructions are most realistic and constraining the sources of uncertainty.

I think Section 2 is a bit confusing to follow. What is it that you want to show? Is it only to give a hint of the outline of the paper? That could be done much simpler. Section 1 introduces about the same concepts in a nice way, and the rest of the paper gives the details. It's hard to know if this is a description of the paper or something more general about the LandCover6k methodology (if these two are the same, please say so). I think that the rest of the paper will be easier to read if Section 2 clearly lists the

three main points: 1) ways to improve data 2) ways to test data 3) the protocol. If this structure is kept and clear for the rest of the paper it will be easier to follow. Because it's mixture of methods and results that is not always so easy to follow. This Section was designed to explain the methodology we are using and in particular the different phases of work. within the protocol. In response to comments by Almut Arneth we propose to revise this section to make it clearer about the three different phases of work outlined in this protocol, i.e. (a). using archaeological data to refine LULC scenarios, (b) testing the revised scenarios and (c) running climate model simulations to examine the impact of LULC changes on climate, as follows: Because of the inherent uncertainties, we advocate an iterative approach to incorporate archaeological data into LULC scenarios in LandCover6k (Fig. 2). We propose to revise the LULC scenario by incorporation of diverse archaeological inputs (Fig. 2, phase 1; see Sections 3 and 4) and to test the revised LULC scenarios for their plausibility and consistency with other lines of evidence (Fig. 2, phase 2 with iterative testing; see Sections 5-7). As a first test, the revised LULC scenarios of the extent of cropland and grazing land through time will be compared with independent data on land-cover changes, specifically pollen-based reconstructions of the extent of open land (see e.g. Trondman et al., 2015; Kaplan et al., 2017) (Section 5). Further testing the LULC scenarios involve sensitivity tests using global climate models (Section 6) and global vegetation-carbon cycle models (Section 7). While the computational cost of the climate simulations can be minimized using equilibrium time-slice simulations, the carbon cycle constraint relies on transient simulations, but may be derived from uncoupled, land-only simulations. Simulated climates at key times can be evaluated against reconstructions of climate variables (e.g. Bartlein et al., 2011) (Section 6). The parallel evolution of CO2 and its isotopic composition (δ13C) can be used to derive the carbon balance of the terrestrial biosphere and the ocean separately (Elsig et al., 2009) and, in combination with estimates for other contributors to land carbon changes such as C sequestration by peat buildup, provides a strong constraint on the evolution of LULC through time. An under- or over-prediction of anthropogenic LULC-related CO2 emissions during a

specific interval results in consequences for the dynamics of the atmospheric greenhouse gas burden in subsequent times (Stocker et al., 2017) (Section 7). Thus, these tests can be used to identify issues in the original archaeological datasets and/or the way these data were incorporated into the LULC scenarios that require further refinement. Phase 3 of the protocol (Fig. 2) proposes specific implementation of the revised LULC in Earth System Model simulations (Section 8). In Section 5 I don't get if REVEALS is used as an input to the LULC reconstructions or if it is used to evaluate the reconstruction. Is it only the fraction of open land that is evaluated? How is land cover reconstructed without REVEALS as the archaeological data (as I understand it) only give fraction of open land/land use. The REVEALS reconstructions are being used here as a way of evaluating the LULC reconstructions derived from archaeological information. REVEALS reconstructions could be used as input to the LULC scenarios, especially in regions where the archaeological information is sparse, but as we explain in the text (lines 333-339) there are problems in doing this because (a) pollen-based reconstructions cannot distinguish between anthropogenic and climatically determined natural open land (e.g. natural grasslands, steppes, wetlands) and (b) REVEALS underestimates cropland cover because there are no RPP estimates for cultivars other than cereals. In contrast, the archaeological data provides information on different types of agriculture (crops versus grazing versus mixed) and the types of crops being grown, direct information on the area affected and indirect estimates of the land-use per capita associated with different types of agriculture at different times that can be used to infer the area being used. However, since there is some confusion about the different information obtained from the two different sources and how we will use the REVEALS data for evaluation we will expand the text to explain this procedure more explicitly, as follows: Pollen-based vegetation reconstructions can be used to corroborate archaeological information on the date of first agriculture from the appearance of cereals and agricultural weeds. These reconstructions can also be used to test the LULC reconstructions, either using relative changes in forest cover or reconstructions of the area occupied by different land cover types. LandCover6k uses the REVEALS

model (Sugita, 2007) to estimate vegetation cover from fossil pollen assemblages. The REVEALS model predicts the relationship between pollen deposition in large lakes and the abundance of individual plant taxa in the surrounding vegetation at a large spatial scale (ca. 100 km x 100 km; Hellman et al., 2008a, b) using models of pollen dispersal and deposition. REVEALS can also be used with pollen records from multiple small lakes or peat bogs (Trondman et al., 2016) although this results in larger uncertainties in the estimated area occupied by individual taxa. The estimates obtained for individual taxa are summed to produce estimates of the area occupied by either plant functional (e.g. summer-green trees, evergreen trees) or land cover (e.g. open land, grazing land, cropland) types. We will also add a final sentence to this section as follows: However, overestimation of the area of open land in the LULC scenarios might suggest problems either in the archaeological inputs or their implementation, especially for times or regions when other evidence indicates cereals were the major crop. In this sense, despite potential problems, the LandCover6k pollen-based reconstructions of land cover will provide an important independent test of the revised LULC scenarios.

For Section 6 I have a few concerns. First, should results be a part of a protocol paper? If it should, why are the results buried in the caption of Fig. 8? Are they old or new results? Make a proper paragraph explaining the results. Section 6 is describing our approach for evaluating the new LULC scenarios by seeing whether they have an impact on simulated climate, and whether this impact is to produce a better a better simulation of climate or not. We illustrate this approach by showing two existing simulations, one with and one without LULC changes. The simulations are published and we cite this publication (Smith et al., 2016). It is not our intention here to comment on the simulations themselves, simply to illustrate how we would evaluate new simulations. We can clarify this by modifying the caption, as follows: Quantitative comparison of the change in climate between the mid-Holocene (6ka) and the pre-industrial period as shown by pollen-based reconstructions (from Bartlein et al., 2011) and in simulations with and without the incorporation of land-use change (from Smith et al., 2016). This figure illustrates the approach that will be taken to evaluate the impact of new LULC scenarios

on climate. The imposed land-use changes at 6ka were derived from the KK10 scenario (Kaplan et al., 2011). The plots show comparisons of mean annual temperature (MAT), mean temperature of the coldest month (MTCO) and mean annual precipitation (MAP) for the northern extratropics (north of 30° N). Although the incorporation of land use produces somewhat warmer and wetter climates in these simulations, overall the incorporation of land-use produces no improvement of the simulated climates at sites with pollen-based reconstructions. Second, the studies of LULC effects on simulated paleo climate that I'm familiar with tell clearly that despite radical changes in land cover the, although significant, differences in simulated climate are small compared to the uncertainty range in the proxies. It is not possible to assess which land-cover description is the most reasonable on the basis of a comparison of modelled climate with paleo climate reconstructions. (e.g. Strandberg et al., 2011; Strandberg et al., 2014). Your own results show this also. How do you plan to overcome this? The Smith et al. simulations show regional changes in summer temperature (JJA) due to LULC of 2-3 degrees C in e.g. North America, Europe and China in the late Holocene, and changes of the same magnitude for more limited regions in the early Holocene. This is certainly within the detection range of the pollen-based reconstructions of summer temperature for these regions. Thus, we are sure that such comparisons will be a useful additional assessment of the new LULC simulations. In fact, in the Smith et al. simulations shown in Figure 8 to illustrate our approach, show an improvement in simulated climate in the high latitudes (increased warming) that is offset in this comparison by a degradation in simulated climate elsewhere. Thus, in our evaluations of the impact LULC on simulated climate we will necessarily have to make more detailed regional comparisons – and this will be useful information for the diagnosis of the improved LULC simulations because it might pinpoint regions where the imposed LULC is wrong. We have already modified this paragraph in response to comments by KjellstroìĹm to clarify this point, as follows: A second test of the realism of the improved LULC scenarios is to examine whether incorporating LULC changes improves the realism of the simulated climate when compared to palaeoclimate reconstructions

(Figure 8). The mid-Holocene (6000 years ago, 6ka BP) is an ideal candidate for such a test because benchmark data sets of quantitative climate reconstructions are available (e.g. Bartlein et al., 2011), the interval has been a focus through multiple phases of PMIP and control simulations with no LULC have already been run, and evaluation of these simulations has identified regions where there are major discrepancies between simulated and observed climates e.g. the observed expansion of northern hemisphere monsoons, climate changes over Europe, the magnitude of high-latitude warming, and wetter conditions in central Eurasia (Mauri et al., 2014; Harrison et al., 2015; Bartlein et al., 2017). There are discernible anthropogenic impacts on the landscape in many of these regions by 6 ka, although they are not as strong as during the later Holocene and they are not present everywhere. Nevertheless, the 6ka BP interval provides a good focus for testing improvements to the LULC scenarios. Such an evaluation would need to go beyond the global comparison made here (Figure 8) to regional comparisons to identify whether improvements in regions where there is a large anthropogenic impact on land cover do not result in a degradation in the simulated climate elsewhere.

Minor comments L53: IPCC SRLUCC says 70% did you do a different kind of estimate? If you did, please explain why it's different. To clarify, the estimate we provide is taken from the cited references. It is obviously difficult to provide an overall estimate of how much of the land surface is affected by human activities because it depends on whether the focus is on direct appropriation for agriculture resulting in a fundamental change in land cover or whether any anthropogenic influence is being taken into account. In fact, the Land Report states (section 1.1.2.2) that between 60–85% of the total forested area and between 72-89% of non-forested land is used, but it also makes it clear that the level of usage is variable with only 10% being intensively managed, two-thirds being moderately managed and the remainder at low intensities. Only about one third of the used land is associated with changed land cover. The Report states that differences in definitions and lack of information about management practice means that the estimates of human usage are uncertain. So, in this sense our statement is compatible with the Land Report, in that the estimated 40% refers to the

area being used for agriculture and we go on to say that large parts of the rest of the land area are being influenced in some way by human activities. However, our point here is not to quantify the extent of use but simply to point out that there is considerable anthropogenic modification on the landscape globally. We will acknowledge the work of the Land Report – which came out after we submitted this paper – and modify this sentence as follows: Today, ca 10% the ice-free land surface is estimated to be intensively managed and much of the reminder is under less intense anthropogenic use or influenced by human activities (Arneth et al., 2019).

L61: I don't think it's good to have the abbreviation LULC after the sentence "...as a result of land use". I guess LULC means land use and land cover. Spell out LULC before "affects the carbon cycle" on line 64 instead. The sentence currently reads "changes in land cover as a result of land use (LULC)". We can expand this as follows: .... changes in land cover as a result of land use (land use land cover: LULC)

L95: "differences in the underlying assumptions" It would be interesting to know about what these assumptions are. We agree that we could be more explicit here and will change the sentence to read: However, differences in the underlying assumptions about land-use per capita, which are generalized from limited and often site-specific data, have resulted in large differences in the final reconstructions (Gaillard et al., 2010; Kaplan et al., 2017).

L175. "LULC scenarios" Is "scenarios" the right word here? I would go for "reconstruction" as "scenario" for me means an assumption about the future, with emphasis on the word assumption. These "LULC scenarios" are not based on assumptions but "a number of products", i.e. they are in some way based on facts. The term scenario is indeed used to describes a trajectory of change in the future based on making assumptions about e.g. behaviour patterns. It can equally well be used to apply to the past LULC changes which may be informed to some extent by data but are also underpinned by assumptions. Indeed, as we point out (see response above) it is these assumptions that give rise to the very large differences between the different "products" currently

available. We do not claim that incorporating archaeological information will change the basis for scenario-creation; merely that incorporating more data that will help refine these assumptions, the resulting scenarios will become more realistic.

L229. “expert knowledge”. How is “expert knowledge” done, is it even a method? Please explain and/or rephrase. There are some regions where there are very few archaeological sites and where statistical methods are therefore difficult to apply. In such regions, we will be forced to use the insights of the archaeologists who worked on the sites about what kind of land use the archaeological records imply. We feel that this is more informative than leaving grid cells blank. We will change the sentence to read: The LandCover6k land-use maps (see e.g. Fig. 5) will be based on different methods ranging from kernel-density estimates to expert assessments depending on the quality and quantity of the archaeological information available from different regions.

L281-295. Here, references to the different panels in Fig. 6 would be helpful. We will modify the figure to add labels so that we refer to the separate panels in the text.

L328-329. How is this done globally, is it possible to do on a global scale? It is not necessary to have global reconstructions to evaluate LULC scenarios, although this is of course desirable. The ultimate goal of PAGES LandCover6k is to provide such reconstructions globally, and we explain that lack of tropical RPPs is the current limitation on providing a global reconstruction using REVEALS. As we point out in our response to a comment by Almut Arneth about the likelihood of having global reconstructions, LandCover6k has been collecting tropical RPPs which will thus facilitate global reconstructions. Furthermore, as we point out in the paper, there are alternative methods that have been used in regions where there are no RPPs and these reconstructions can also be used to evaluate the LULC scenarios. We have expanded the text describing the pollen-based reconstructions (in response to Almut’s comments), as follows: The REVEALS approach has been used to reconstruct changes in the amount of open land through time across the northern extratropics (Figure 7; Dawson et al., 2018) through the Holocene with a time resolution of 500 years from 11.5ka to 0.7ka BP,

and three historical time windows (modern–0.1ka BP, 0.1–0.35ka BP, and 0.35–0.7ka BP). A major limitation in applying REVEALS globally is requirement for information about the relative pollen productivity (RPP) of individual pollen taxa, which is currently largely lacking for the tropics. However, LandCover6k has been collecting RPPs for China, South-East India, Cameroon, Brazil and Argentina and pollen-based land-cover reconstructions will be available for at sufficient parts of the tropics to allow testing of the scenarios. Another limitation of REVEALS estimates is that RPP estimates are available for cultivated cereals but not for other cultivars or cropland weeds, so the LandCover6k reconstructions will generally underestimate cropland cover (Trondman et al., 2015). It may also be possible to use alternative pollen-based reconstructions of land cover changes, such as the Modern Analogue Approach (MAT: e.g. Tarasov et al., 2007; Zanon et al. 2018); pseudo-biomization (e.g. Fyfe et al., 2014) or STEPPS (Dawson et al., 2016). While none of these methods require RPPs, MAT and STEPPS can only be applied in regions where the pollen datasets have dense coverage (such as Europe and North America) and pseudo-biomization is affected by the non-linearity of the pollen-vegetation relationship that the REVEALS approach is designed to remove. L332. “transient” and “500 years”. Is it correct to call something with 500 year resolution transient? Or should it rather be time slices. Compare the use of “transient” in Section 8. It is true that in a modelling context we use the term transient to mean "every year" whereas the pollen-based reconstructions are currently snapshots at 500 year intervals, except in the last millennium. It would be possible to provide reconstructions at finer intervals, for example at 50 year intervals subject to the sampling resolution and the uncertainty of the age model of the individual pollen cores. We will modify the wording here to differentiate between the model simulations and the pollen-based reconstructions, as follows: LandCover6k has already produced reconstructions for the northern extratropics. These reconstructions provide snapshots through the Holocene with a time resolution of 500 years until 0.7ka BP, and three historical time windows (modern–0.1ka BP, 0.1–0.35ka BP, and 0.35–0.7ka BP). L405. “contributions to the land C inventory can be specified...” Is this possible to achieve? Your assumption

builds on that. The main independent contribution to the land C inventory is the build up of peat through the Holocene and this is, at least to first order, known from syntheses of peat records. We can expand this text to be more specific, as follows: Providing that all of the natural contributions to the land C inventory (e.g. the build up of natural peatlands: Loisel et al., 2014) can be specified from independent evidence, the anthropogenic sources can be estimated as the difference between the total terrestrial C budget and natural contributions (Figure 9) at any specific time.

Additional reference Loisel J, Yu Z, Beilman DW, Camill P, Alm J, Amesbury MJ, Anderson D, Andersson S, Bochicchio C, Barber K, Belyea LR, Bunbury J, Chambers FM, Charman DJ, Vleeschouwer FD, Fiałkiewicz-Kozieł B, Finkelstein SA, Gałka M, Garneau M, Hammarlund D, Hinchcliffe W, Holmquist J, Hughes P, Jones MC, Klein ES, Kokfelt U, Korhola A, Kuhry P, Lamarre A, Lamentowicz M, Large D, Lavoie M, MacDonald G, Magnan G, Mäkilä M, Mallon G, Mathijssen P, Mauquoy D, McCarroll J, Moore TR, Nichols J, O'Reilly B, Oksanen P, Packalen M, Peteet D, Richard PJ, Robinson S, Ronkainen T, Rundgren M, Sannel ABK, Tarnocai C, Thom T, Tuittila E-S, Turetsky M, Väliranta M, Linden Mvd, Geel Bv, Bellen Sv, Vitt D, Zhao Y & Zhou W, 2014. A database and synthesis of northern peatland soil properties and Holocene carbon and nitrogen accumulation. The Holocene 24: 1028-1042

L542-545. This is not possible without first improving proxy data. We do not understand this comment. The point of this protocol paper is to explain how we will improve the land use scenarios so that they can be used to drive model simulations. The point here is that these experiments could be used to explore whether the land-use changes are implicated in e.g. abrupt events or whether specific land-use changes associated with population changes used in the scenarios produce significant effects on climate. Fig. 3 The text is far too small. No explanation for the grey shading or the white dots is given. A similar point was raised by KjellstroÌĹm and we have expanded the text and modified the caption to explain this figure better

Fig. 4 Two boxes in Level 1 don't connect to Level 2. I can see that "No human land use"

doesn't have to connect to Level 2, but is it then necessary to include it in the figure? I don't see how "Extensive/Minimal land use" fits in the picture. As we have said in our response to KjellstroÌĹm, the Figure is included for illustrative purposes and shows the scheme of land-use categories developed by LandCover6k to be used by the archaeological community to map land-use in different regions of the world. The terminology is that used to describe different kinds of agriculture by archaeologists, and there is a handbook (which we can refer to) that defines these terms. As we explain in the text, these land-use types will have to be translated to the anthropogenic land-use types used in ALCC scenario models and then trasnslated again in land-use harmonization schemes to produce quantitative estimates before being used for climate model simulations. The level of categorisation that is possible or necessary varies depending on the type of land use: it is clearly not useful to subdivide categories such as "no human land use" or "extensive/minimal land use". In the same way, there is no basis for subdividing some of the level 2 categories. For example, if there is "specialised fish production" it doesn't much matter what kind of fish are being farmed whereas if there is wet cultivation it does matter what type of crop is being grown and whether the wetland was natural or created for the purpose. We have already expanded this paragraph somewhat in response to comments by Almut Arneth, but we will further refine it to clarify the scheme as follows: Maps of the distribution of archaeological sites or of areas linked to a given food production system have been produced for individual site catchments or small regions (e.g. Zimmermann et al., 2009; Barton et al., 2010; Kay et al., in press). LandCover6k is developing global land-use maps for specific time windows, based on a global hierarchical classification of land-use categories (Morrison et al., 2018) based on land-use types that are widely recognised from the archaeological record. At the highest level, the maps distinguish between areas where there is no (or only limited) evidence of land use, and areas characterized by hunting/foraging/fishing activities, pastoralism, agriculture, and urban/extractive land use (Fig. 4). Except in the cases where land use is minimal (no human land use, extensive/minimal land use), further distinctions are subsequently made to encompass the diversity of land-use ac-

tivities in each land-use type (Fig. 4). A third level of distinction is made in the case of two categories (agroforestry, wet cultivation) where there are very different levels of intervention in different regions. Explanations of this terminology are given in Morrison et al. (2018). The LandCover6k land-use maps (see e.g. Fig. 5) will be based on different methods ranging from kernel-density estimates to expert knowledge depending on the quality and quantity of the archaeological information available from different regions.

Fig. 5 Too small legends. We will provide new figures to ensure that they are readable. Please see detailed explanations in the response to KjellstroÌĹm.

Fig. 6 I don't understand the coupling between "LandCover 6k working group" and "HYDE 3.x". What does "→" mean? I don't understand many of the panels. What are the axes? What are the squares? What is the grey shading? A similar point was raised by KjellstroÌĹm and we have expanded the text and modified the caption to explain this figure better

Fig. 7 Far too small legends. We will provide new figures to ensure that they are readable. Please see detailed explanations in the response to KjellstroÌĹm.

Fig. 9 I don't understand this, but it seems to be more complicated than it sounds, but the surrounding text doesn't give much help. The text here describes the basis for using carbon cycle constraints on LULC. We will modify the caption to the Figure to clarify what this illustrative figure shows and so that it can be better understood in relation to the surrounding text, as follows: Illustration of the terrestrial C budget approach to evaluate LULC. The total terrestrial C balance (green circle 'total') is constrained by ice core records. The remainder (yellow slice 'remainder') is then calculated as the total terrestrial C balance (green circle 'total') minus the sum of separate estimates of natural components (blue slices 'Natural components') derived from modelling and/or upscaled observations. The remainder is effectively the emissions resulting from LULC changes, and can therefore be compared to LULC CO2 emission estimates by carbon-cycle models.

Table 1 What does “Modern” mean here? If it is pre-industrial say so. If it is modern (= 20th century) explain why you don’t use pre-industrial. This point has been raised by KjellstroÌĹm and we have explained in that response that the PMIP protocol mandates modern geography and ice sheets for the pre-industrial simulation. We have expanded the text to explain this and modified the caption also.

Please also note the supplement to this comment:
https://www.geosci-model-dev-discuss.net/gmd-2019-125/gmd-2019-125-AC6-supplement.pdf

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